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WOMEN AND SCIENCE

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FOREWORD

Improving the status of women and making the benefits of science and technology available to all the world's people have been major concerns of the United Nations since its inception. In recent years, they have frequently been discussed in connexion with such issues as development, population and food, and are generally accepted as essential elements in achieving a New International Economic Order. But, while the interdependence of almost all global concerns is widely recognized today, little has been said about the relationship between women and science and technology. In more specific terms, scant attention has been paid to the contribution science and technology can make to improving women's status, and to the contributions women can make in these important fields.

In the former case, it seems to be understood that women will benefit along with everyone else from scientific and technological development. But this is not necessarily so, as we have seen, for example, from reports about certain rural areas in Africa where women have always made up the greater part of the agricultural labour force. Frequently, when modern agricultural techniques have been introduced in these areas, training has been directed towards men, and not women. As a result, women have been deprived of their traditional occupation and lost both income and status. The impact of science and technology on women is indeed a subject which requires much study but, like many subjects that involve women, little in the way of research on a world-wide level is available.

A similar situation exists concerning the impact of women on science and technology—the subject of this booklet. Only since the International Women's Year in 1975 and its Conference in Mexico City has this subject received much notice on a global scale. Now, with the United Nations Decade for Women: Equality, Development and Peace 1976-1985 in full swing, the importance of involving a much greater number of women in this field deserves wide attention.

The decisions taken at both the United Nations Conference on Science and Technology in August 1979 at Vienna and the Second United Nations World Conference on Women to be held in 1980 at Copenhagen are expected to have a wide-ranging effect on this issue. The participation of women in discussing this and other issues at these and other world conferences is a major step towards arriving at a more equitable world community. Recently, Mrs. Helvi Sipilä, Assistant Secretary-General for Social Development and Humanitarian Affairs and the highest ranking woman in the United Nations Secretariat, told a UN meeting:

> "As problems of the world are so enormous, and as the interdependence of all nations is increasingly understood, the solutions cannot be expected to be easier to find by excluding the resources, consisting of half of humanity, from full participation in their consideration at the governmental and intergovernmental level everywhere."

WOMEN AND THE SCIENCES

INTRODUCTION

Nothing can be more absurd than the practice, which prevails in our country, of men and women not following the same pursuits with all their strength and with one mind, for thus the state, instead of being a whole, is reduced to a half.

Plato

At a time in the history of our planet when all the best minds are needed to build a better future for all the world's people, half is not enough. Like other natural resources, brainpower is not infinite. We must use what is available, and this means women's brainpower. Since, increasingly, our universe runs on science and technology, it is in the interests of all nations that women assume a more active scientific and technological role than they have in most countries. There is no imaginable inherent reason why they should not. Science, for the most part, does not demand extraordinary physical strength, nor, in most cases, does it involve dangerous risks, not that some women are not as strong and adept at risk-taking as men. Still, scientists do not have to carry heavy weights or engage in hand-to-hand combat. What science does require is intelligence, aptitude and concentration—qualities just as apt to be present in women as they are in men.

A comparatively small number of women have so far gained recognition for their contributions to science. What has enabled them to succeed where others have failed? What has prevented and continues to prevent more women from carving a place for themselves in the scientific world? There are no easy answers to these questions. Many prominent women scientists have certain factors in common in their backgrounds, but there is no way of telling how many other women possessing these same factors do not attain prominence or even a graduate degree in science. In some cases, the obstacles women in science face are basic to all societies. In other cases, some obstacles tend to be more prevalent in certain places than in others. In almost all cases, however, the obstacles have far more to do with the status of women in general than they do with the status of women in science alone. It is nearly always a case of unequal rights; this is the problem. Equality for women in science would surely contribute to equality for all women. Equality for all women will ensure not only equality for women in science, but a world operating at full, and not half, potential.

CHAPTER I

WOMEN SCIENTISTS OF THE PAST

There have always been women who have been exceptions to the rule—women who have done what men have done. But in the history of the sciences, there appear to be fewer of these exceptions than in other fields. Why? The dedication required and the prejudice encountered seem to have combined to keep women at bay. And for those who have ventured into this

forbidden territory, recognition has been rare. One writer has pointed out that women's accomplishments in the arts and letters, for example, seldom receive equal consideration with men's. "The work of great women painters is often assessed in comparison with other women painters, and not *all* painters. Women writers suffer the same fate. . . . Uniquely in science, the work of women that has surfaced has been given the same assessment as the work of men, because contributions in science defy sexualizing."

Yet very few of the women who have achieved scientific prominence appear on the pages of scientific historical reference books. One tome which contains the biographies of over a thousand scientists of the past includes only three women—Madame Marie Curie, Irène Joliot-Curie and nuclear physicist Lise Meitner. Thanks to books, articles and a romanticized film biography, Madame Curie has become well-known. The discoverer of the nature of radioactivity and of two elements—radium and polonium—and the only person to win two Nobel Prizes in science—in physics and chemistry—she ranks high on any list of notable scientists. A remarkable woman from many points of view, she never sought to profit from her work and never patented the process of radium extraction. On the death of her husband and collaborator, Pierre Curie, in a traffic accident in 1906, she took over his professorship at the Sorbonne and became the first woman to teach there.

Madame Curie's elder daughter, Irène Joliot-Curie, working with her husband, Féderic Joliot, discovered artificial radioactivity. Together, they shared the 1935 Nobel Prize in chemistry. Her later work contributed to the discovery of nuclear fission. In 1936, she was appointed to the French Government as Under-Secretary of State for Scientific Research, and from 1946 to 1951, she was one of four scientific commissioners for the French atomic energy project. Like her mother, she died of leukemia from over-exposure to radiation.

Austrian-born Lise Meitner, renowned for her work in radioactivity and in nuclear physics, first became interested in science when she read of the Curies' discovery of radium in 1902. Forced to flee Nazi-occupied Austria in the 1930s, she went to Sweden. There, with her nephew, O. Robert Frisch, and working with information supplied by her long-time associate, chemist Otto Hahn, she observed that neutron bombardment of a uranium nucleus caused it to divide into two smaller nuclei with a consequent release of great energy. They applied the name "fission" to this process of nuclear splitting. Their work led to extensive research in many countries. This, in turn, provided the basis for the subsequent construction of the atom bomb. Lise Meitner refused to work on the bomb. Instead, she remained in Sweden and continued her research. She died in England in 1968, just 11 days short of her 90th birthday.

There were, of course, other famous women scientists. In ancient times, there was Khana the astronomer, Leelavati the mathematician in India, and Hypatia of Alexandria, a noted teacher, who wrote commentaries on the work of earlier

scholars. In the 13th century, the nuns at the German convent of Helfta wrote scientific treatises as well as religious works in Latin.

It is interesting to note that Medieval convents offered to a few women an almost unparalleled opportunity for intellectual development. Describing the life of an abbess, one book says:

> "Great spiritual rewards and great worldly prizes were alike within her grasp. She was treated as an equal by men. . . . She had the stimulus of competition with men in executive capacity, in scholarship, and in artistic production since her work was freely set before the general public; but she was relieved by the circumstances of her environment from the ceaseless competition in common life of woman with woman for the favour of the individual man."

One might add that she was also relieved of housework, child-care and many other responsibilities of secular life. In effect, she was free to devote herself to her work.

But outside the cloistered life, other women scholars attained eminence as well. Christina de Pisan, an Italian who lived in Paris at the court of the king at the turn of the 14th century, studied Plato and "the Arabian sciences". She was chiefly known, however, for her fearless and radical writings in which she formulated Utopian demands for the emancipation of her sex. Paris, too, was the home of several famous women doctors. Most remarkable of them was Jacqueline Felicie de Almania, who was prosecuted in 1322 by the medical faculty of Paris for practising without a degree and a licence. A witness in her defence stated that she was reputed to be "wiser in the art of surgery and medicine than the greatest master doctor or surgeon in Paris". Among other women doctors prosecuted at the same time were Joanna, called "lay sister but a married woman", Belota the Jewess and Margaret of Ypres.

Family medicine, nursing and midwifery were always the domain of women and various treatises on women's diseases, written or translated for their use, existed by the 14th century. By the 16th century, cities were certifying midwives who were usually mature, experienced women, trained by doctors who themselves had never practised obstetrics. A 1556 Strasbourg city regulation stipulated that women applying for "the honoured post of a sworn-in midwife" had to pass an examination conducted by the city doctor in the presence of some respected and experienced women burghers appointed by the city council. Ten years later, Anna, wife of Augustus, Elector of Saxony, established a school for midwives in Dresden where she herself gave practical instruction. Having given birth to 15 children in 37 years of marriage, she deemed herself qualified. In 1581, she founded a court pharmacy. Author of a book on medicines, she is also said to have invented one, "white Stomachic water", while experimenting in her husband's laboratory.

The Renaissance brought the sciences to more women. Thanks to the broad educational aims of the humanists, who believed that women should study not only literature, but also geometry, arithmetic and astrology, their participation in art and knowledge reached heights which were not surpassed until

the 19th century. Best known of a group of brilliant Italian women interested in all branches of learning was Isabella d'Este. Surrounding herself with artists and scholars, she studied assiduously and exchanged correspondence with some of the most erudite people of her time. During this period in Italy, it has been written that women not only studied under tutors, but they apparently attended classes in the great universities and even occupied important chairs in the most distinguished faculties. To some extent, their influence spread to other countries of Europe, but the women who took part in this intellectual life were only those of the privileged élite, something that was always true before the Renaissance and has frequently been true since. The majority had no possibility of dealing with the sciences.

English-speaking women did not have much opportunity to distinguish themselves in scientific pursuit until several centuries later. Only one gained fame, but she was not taken very seriously. Margaret Cavandish, Duchess of Newcastle, known as "the most-talked-of learned lady" of the English Restoration period, included a section on anatomy in her *Philosophical and Physical Opinions*. She was much ridiculed for writing this without ever having studied anatomy, but she told detractors that she had observed "the insides of animals and used natural reason".

Italy continued through the 18th century to nurture women scholars. Two noteworthy examples were products of the University of Bologna: Laura Maria Catarina Bassi, who in 1733 became the first woman to occupy the chair of physics at a university, and Maria Gaetana Agnesi, who, substituting for her father, assumed chairmanship of the University's department of mathematics in 1750. It is interesting to note that in recent times, women have occupied major posts in the scientific faculties of Italian universities.

It was during the 1700s that France's famous mining engineer Martine de Beausoleil became known for her work and for urging Cardinal Richelieu to establish a Chambres des Mines. Later in this century, Sophie Germain began her research on mathematical equations which led to her receiving The French Institute prize in 1815.

In England, German-born Caroline Lucretia Herschel became the first noted woman astronomer of modern times. In addition to assisting her brother, William Herschel, discoverer of the planet Uranus and two satellites of the planet Saturn, she herself discovered eight comets.

The term "women in science" took on a new meaning in the 1900s. This century saw the beginning in many countries of a wider participation of women in all facets of life. This participation included the medical and scientific professions. Despite a Harvard University professor's warning that feminine education could only be gained at the expense of women's reproductive functions, women began pushing open the doors to scientific and medical faculties.

One of the most compelling reasons why women wanted to become doctors, and why they were finally allowed to do so, was to take care of "feminine ailments" which otherwise would have gone untreated. Although in the early 19th

century some women were able to obtain a medical education in Paris or in one or two other European cities, such was the modesty of the times in English-speaking countries that it was considered indecent for the subject of anatomy to be discussed in mixed company. This led to the establishment, towards the middle of the century, of separate medical schools for women in England and North America. By the end of the century, a few leading university medical schools had become co-educational. However, at one—the University of Michigan Medical School—duplicate lectures were arranged on any subject likely to create embarrassment. Regardless of the limitations, over seven thousand women doctors were registered in the United States alone by 1900. A number of these physicians had had the opportunity to study at Swiss and German universities which had opened their doors to women in the 1870s.

A few of the outstanding women doctors of the period include England's first woman physician, Dr. James (Miranda) Berry, Inspector General of Hospitals for the British Army, who was discovered to be a woman only after her death; Elizabeth Garrett Anderson, who was also England's first woman mayor (of Aldeburgh); Sophia Jex-Blake, foundress of the London School of Medicine for Women in 1874 and the Edinburgh School of Medicine for Women in 1886; Augusta Klumpke Déjerine of France, a nerve pathology specialist after whom Klumpke's paralysis was named; Elizabeth Blackwell, who, with the help of her sister Emily, also a physician, founded the New York Infirmary for Women and Children in 1857 and the Women's Medical College of the New York Infirmary in 1865; and two women who served as Union Army doctors during the US Civil War. One was women's rights advocate Mary Edwards Walker who set up practice in Washington D.C. where she attracted attention by wearing men's attire and by establishing a women's colony called "Adamless Eden". The other was a Quaker doctor, Mary Myers Thomas. In 1850 the Quakers founded the Female (now Women's) Medical College of Pennsylvania, the only all women's medical school in the US still in existence.

Many of these women never married and some observers referred to the time as a golden age of spinsters. This was certainly not always so. There is one case that comes to mind of a man who first married a noteworthy physician and after her death a brilliant physicist. William Ayrton was himself a noted British electrical engineer, physicist and inventor. The first Mrs. Ayrton, Matilde Chaplin, practised medicine in Britain, France, Algeria, Ireland and Japan where she established a teachers' school for midwives in the 1870s. The second Mrs. Ayrton was Herta Marks, who invented the draftsman's line-divider and the anti-gas fan (used by the British Army in the First World War). Among her discoveries were the connexion between pressure in the electric arc and current length, and the causes and process of formation of ripples in sand at the seashore.

Another woman scientist of the century was Maria Mitchell, America's first woman astronomer, noted for her discovery of a comet in 1847. In 1865, she joined the faculty of Vassar

College when it opened. There she inspired many of her students to become scientists. Among them was Ellen Swallow Richards who went on to be the first woman to study at the Massachusetts Institute of Technology and the first woman member of the American Institute of Mining and Metallurgical Engineers. Unbeknownst to her, she was admitted to MIT without charge so that in case she failed the President of the Institute could say that she was not a student.

Meanwhile, in Russia women had already been able to break into the engineering profession, thanks to the founding of the School of Chemical Engineering to which they were admitted. They also made strides in other fields. In mathematics, for example, Sonya Korvina-Krukovska was noted both for her work on the theory of partial differential equations and for her prize-winning solution in 1888 to one of the problems in the theory of the rotation of a solid about a fixed point.

Harvard University, in the United States, which over the years has gone from one extreme to another in its policy towards admitting women to graduate schools (its medical school did not admit them until 1945), produced several outstanding women astronomers in the late 1800s and early 1900s. This was largely due to the influence of Edward Pickering who was Director of the Harvard Observatory in the 1880s. Pickering first encouraged some 40 women volunteers with some background in mathematics to measure the stars and then was able to expand his programme in celestial photography so that he could pay them 25 to 30 cents an hour to work six days a week for seven hours a day. One of his assistants, Williamina Paton Stevens Fleming, became the first woman curator of the Observatory. She had been a maid in Pickering's house. The story goes that, disgusted with a male assistant, Pickering vowed he could train his maid. Her successor as curator was Annie Jump Cannon, another Pickering protégée, whose monumental work was spectral classification. She classified some 350,000 stars and published her results in a nine-volume work. Another Harvard astronomer was Henrietta Swan Leavitt who, while working at the Harvard Observatory in Peru in 1912, discovered the period luminosity curve to learn the distance of stars.

The turn of the century marked the appearance of a few important US women ethnologists including Erminnie Smith, the first woman elected Fellow of the New York Academy of Sciences, Alice Fletcher and Elsie Clews Parsons, who later influenced anthropologist Ruth Benedict, who, in turn, provided early inspiration to one of the world's leading anthropologists, Margaret Mead.

During the 20th century, women have continued their march into the sciences, and socialism has proven to be their most potent ally. The idea that there was a need for women to go into the sciences and that those who did so were not just a few privileged eccentrics had already gained some acceptance in the previous hundred years. But it was the socialist revolutions of the 20th century that put women in the forefront of these professions in the USSR, the People's Republic of China and the socialist countries of Eastern Europe. Today, in the USSR, for example, 75 per cent of the doctors, nearly 50 per cent of

the scientists and some 40 per cent of the engineers and technicians in the country are women. The changes in government policies and thinking which made this advance possible were perhaps based not only on idealistic conceptions of equal rights but on economic realities—the only way to full-scale economic development was by employing the brains, talents and skills of all the population, both men and women.

This realization is dawning more slowly on Western European and North American countries, despite two World Wars in which women were utilized in all sectors of the economy. Women in these countries have continued to go into the scientific professions in a small, persistent stream, wearing away at the foundations of scientific male supremacy. Many have made notable contributions. Seven Nobel Prizes in science have gone to six of these outstanding women. Besides Madame Curie and Irène Joliot-Curie, Prize-winners have been Gerty Cori (medicine), Marie Goeppert-Mayer (physics), Dorothy Hodgkin (chemistry) and Rosalyn Yalow (medicine).

Gerty Radnitz Cori shared the 1947 Nobel Prize in medicine and physiology with her husband, Carl Cori, for their work on how glycogen, the carbohydrate stored in the liver and muscle, breaks down in the body and is resynthesized. Born in Prague, the Coris emigrated to the United States in 1922. Although they worked together as equal partners, Gerty Cori rarely received equal recognition. In 1931, when Carl Cori was offered a full professorship at Washington University Medical School in St. Louis, Missouri, his wife was offered only a position as fellow and research associate. She attained a full professorship 16 years later, after she had won the Nobel Prize. Similarly, she was only elected to the US National Academy of Science after the Nobel award, eight years after her husband's election. When the Lasker Award for Basic Medical Research was given for their accomplishments, it went to Carl Cori alone.

Born in what is now Katowice, Poland, Marie Goeppert-Mayer studied in Germany but moved to the United States in 1930. While working at the University of Chicago in 1948, she suggested that the atomic nucleus consisted of protons and neutrons arranged in shells, as electrons were arranged in the outer atom. This theory made it possible to explain why some nuclei are more stable than others and why some elements are rich in isotopes. For this work, she won the 1963 Nobel Prize in physics.

The following year, the United Kingdom's Dorothy Crowfoot Hodgkin won the Nobel Prize in chemistry for her study of the molecular structure of cyanocobalamin (Vitamin B_{12}). Mrs. Hodgkin had already tackled the structure of penicillin during the Second World War. During this study, she became the first person to use an electronic computer in direct application to a biochemical problem. With the cyanocobalamin molecule, she again used the electronic computer, but nevertheless it took years to work out the structure in full detail.

Thirteen years passed before another woman was awarded the prestigious Nobel Prize. In 1977, Dr. Rosalyn Yalow received the Nobel in medicine for her work in devising, with her late collaborator, Dr. Solomon A. Berson, radioimmunoassay (RIA). This is a test combining the use of radioactive isotopes with immunology to measure hormones, enzymes and other substances that exist in such low concentrations in the body that they can be impossible to detect by any other laboratory methods. A Nobel Committee member likened the test's sensitivity—it is capable of detecting a billionth of a gram—to the ability to detect the presence of half a lump of sugar in a lake 62 miles in diameter and 30 feet deep. The test has revolutionized biological and medical research.

After graduating from Hunter College of the City of New York with an A.B. in physics and chemistry, Dr. Yalow had considerable difficulty entering graduate school. For some time, she had to work as a secretary at a university in order to continue her education. During the past 30 years, she has worked for the US Veterans Administration Medical Care System and, with little funding, has managed to build up a department of nuclear medicine at the Veterans Administration Hospital in the Bronx (New York City). Married with two grown children, Dr. Yalow takes a keen interest in equal rights for women, especially as it affects equal opportunities in the scientific professions. She has received much recognition for her work and is the first woman to receive the Lasker Award.

The 20th century has so far produced one woman in science who is unique—Valentina Tereshkova-Nikolayeva—the first woman to fly in earth orbit. In 1963, she piloted the Vostok 6 for 48 revolutions about the earth. Born in a small village in the USSR, Tereshkova-Nikolayeva lost her father at an early age and had a difficult childhood. As a young girl, she worked in a tire factory and then in a textile plant while continuing her studies by correspondence at a textile technical school. During this time, she became interested in parachute-jumping as a sport and joined the local air club. After making 126 jumps, she had become a first degree parachutist. Following Yuri Gagarin's space flight, she, like many experienced parachutists, was interviewed in connexion with the Soviet cosmonaut training programme. Shortly thereafter, she was accepted as the first woman cosmonaut trainee. She underwent extensive training in such scientific and technical subjects as astronomy, geophysics, rocket engineering, radio engineering, the spaceship and its systems as well as stringent physical conditioning. After her history-making flight, Tereshkova-Nikolayeva married another cosmonaut, Andrian Nikolayev and became the mother of a "healthy and cheerful daughter", another proof, she has said, "that flight in space has no harmful effects on women". She was appointed Chairman of the Soviet Women's Committee and has represented her country at official functions in many parts of the world.

CHAPTER 2

ON BECOMING A WOMAN SCIENTIST–WHAT CAN HELP?

What, besides intelligence, aptitude, concentration and persistence, did most of these women scientists of the past have in common? Frequently, they had a father in a profession, a working and/or educated mother, a supportive husband, or, if they remained unmarried, an interested colleague. In addition to these assets was what sociologists refer to as a "role model"–a professional heroine, some woman who inspired them, whom they could admire and emulate. Such emotional support does not, of course, guarantee success in science, but it certainly appears to help.

At a 1972 Conference on Successful Women in the Sciences in the United States, one participant looked back over the lives of some of these women and said:

> "For all, the encouragement or discouragement of an influential person made an essential difference in their development. They affirm what is striking in history: that women's expectations have grown because some people and some institutions have believed in them. Whether during childhood, school days, college, graduate or professional years, these women have had special encouragement from one or more people: father, mother, teacher, friend or professional colleague. . . ."

Fathers play a particularly important role. This has been evident from ancient times when Theon of the Great Museum of Alexandria tutored his daughter, Hypatia, down to Madame Curie's physics teacher-father and on to many fathers of women college students today. A father's love and encouragement can broaden a daughter's intellectual horizon and boost her self-confidence. One study found that when fathers treated their daughters as if they were interesting people who were worthy and deserving of respect and encouragement the women understood that their femininity would not be endangered by developing their talents and that their fathers did not feel threatened by their ambitions. When these men also treated their daughters with courtesy and affection as they encouraged them in developing their talents, the study said, "One could say that the fathers gave their daughters 'permission' to be whole persons, to develop a variety of interests without concern that their femininity was at stake".

The importance of masculine encouragement cannot seemingly be overstressed. Research on the lives of European and American career women, dating back to the 15th century, shows striking similarities to a survey of US college women in the 1960s. In both, it was the father or some important male who had encouraged and guided these women to persist in developing their talents.

The protégées of Edward Pickering, the wives of William Ayrton, such scientifically productive husband-and-wife teams as the Curies, the Joliot-Curies and the Coris are illustrations of this kind of encouragement. So are examples of collaboration

such as that between Caroline Herschel and her brother, William, and between Lise Meitner and Otto Hahn.

Unfortunately, some people—male and female—are quick to belittle the achievements of women in collaborative efforts, giving greater credit to the male partners. Occasionally, this attitude is carried over to successful women who have supportive husbands or friends in other fields. An illogical sort of Trilby-Svengali relationship is sometimes implied—"She could never have accomplished that if she weren't married to (or the friend of) so-and-so"—as if female achievement depended on males. One rarely, if ever, hears such comments about successful men (and then only if their wives are rich or have influential male relatives), except in the sense of the traditional helpmate—the "woman behind the man".

This attitude is not necessarily the fault of men. Although one comes across references to an "earth mother" in ancient times and there have existed primitive societies ruled by women, by and large, men have always been considered "the first sex". And they have been brought up by their mothers and the rest of society to believe in their own superiority. In the past, this attitude was reinforced by laws and regulations, by religion, by custom. It still exists today and, despite legislative changes in some parts of the world, it continues to be passed on from generation to generation because this is the way things have always been. But this does not make it right any more than the fact that because nations have always fought wars, wars are right. Both male superiority and wars are destructive and dangerous to the world's future, facts men have often recognized much earlier than women have.

At an encounter for journalists at the 1975 United Nations Conference for the International Women's Year in Mexico City, former Colombian Ambassador to UNESCO Esmeralda Arboleda Cuevas described the great encouragement she had received from her father and her husband. She said that because of them she had been able to accomplish much more in her life than she had ever imagined possible. Delving further into this subject, she suggested that perhaps the reason there were no female Beethovens or Rembrandts and so few great women creative artists was due to the lack of the kind of encouragement and support men traditionally receive from women—mothers, wives, mistresses. When women provide this to men, it is almost always taken for granted and almost never given any credit. But it is precisely the kind of encouragement and support that all creative people need, regardless of whether they are in the arts or sciences, and regardless of their sex. Because creativity, just as scientific discovery, means breaking new ground; because it involves professional competition to get there first; and because it requires tremendous effort, it also requires emotional and sometimes other kinds of support. The lack of such support is a key problem for women in all societies.

As we shall see, socialist countries have been able to change the accepted image of women in many ways, thus facilitating their entry in all sectors of the economy. But even in socialist countries, the idea that men can, in a different way, provide

emotional support and encouragement to women seems to be making slow headway. In a certain sense, what seems to have happened is that the new image of the hard-working, economically productive woman has been superimposed on the traditional image of the maternal, sacrificing, home-making woman. This may contribute to the fact that although women, for example, in the Soviet Union are well-represented in the scientific and technological fields, they do not, in proportion to their numbers, occupy the highest posts; nor have individual Soviet women scientists received recognition for accomplishments that, considering their predominance in the field, one might expect. This, however, may also be due to the fact that since they, like most scientists, work in groups, their accomplishments may be considered group achievements, while, in some Western countries, the group's achievements are frequently credited to the group's chief.

Thanks to government policy carried out largely through the mass media, the propagation of an appropriate "role model" is no problem in socialist countries. But much has been made of its absence in such places as the United States. For a few pioneering women of the 19th century, lack of a "role model" was actually an inspiration. Militant feminists like Elizabeth Blackwell, the first female doctor in the US, went into certain fields simply because there were no women. Of M. Carey Thomas, President of Bryn Mawr College and the first woman from any country to receive a Ph.D. from the University of Zurich (1882, *summa cum laude*), it was said, "Obstacles were stimuli to her and others in the first generation of professionally trained women. It was not only that they were crusaders, but also they had been brought up to accept the rigors of hard thinking and hard work."

Madame Curie, possibly the most outstanding "role model" for women scientists, may have herself been inspired by her mother, the principal of a girls' school. She certainly had a strong influence on her own daughter, Irène Joliot-Curie, who worked with her, and on Lise Meitner, as well as many, many others. That mother "role models" have a strong impact on both daughters and sons was brought out by a recent Israeli study. It noted that women with mothers in high-status jobs tended to follow their example, particularly if the mothers worked in positions usually thought of as masculine. Both sons and daughters of such women tended to achieve similar positions with greater frequency than children of men in high-status positions.

Repeatedly in research on scientific women's "role models", the importance of women professors is emphasized. One would think that these women would go out of their way to encourage their female students. This, however, does not always seem to be the case. A chemistry professor has observed:

> "Unfortunately, until recently, few 'successful' women scientists (with notable exceptions) have been active in promoting careers of other women. Although they might encourage undergraduates, they remain aloof from would-be protégées, preferring the specialness that accrues from being the only women among many men."

This "specialness", this exceptional-woman status sometimes leads to an attitude which certain sociologists liken to that of "marginal" members of minority groups. The "marginal" person is not totally rejected by the group she or he is striving to enter, only partially rejected or partially accepted. Therefore, the outsider tends to adopt the attitudes, prejudices and criteria of the group—in the case of the sciences in most countries—a male-dominated group. Thus, a woman science professor might be just as unsympathetic or more unsympathetic to a young woman student than a male professor in a conscious or unconscious attempt to prove her group-worthiness.

Interestingly enough, several of the "successful women" at the 1972 US Conference on Successful Women in the Sciences were reluctant to be known as "women" scientists. One architect said, "Now, unwillingly, I seem to be part of the Women's Liberation Movement, a fact that I resent because I refuse to be bunched up under the heading 'women'." Many women who feel this way tend to minimize any prejudice they may have encountered and difficulties they may have had in combining marriage, motherhood and careers. They often take the tack that if a woman is willing to work very hard, she can succeed. Another Conference participant pointed out that disavowing your womanhood, so to speak, at a time when women are not fully accepted in these fields, could be detrimental to other women. It implied, she said, that only exceptional women could go into the sciences. Also, she continued, it "suggests that social movements boost only the weak and infirm . . . (and) ignores the fact that most professional women . . . have been able to devote time to their work by giving over part of their motherhood to other (usually lower-class) women whose role remains unchanged". By denying the women's movement, she added, these women forestall the full acceptance that they seek in their professions.

Speaking of the need for women professionals to acknowledge "the mutual dependency of women", a paediatrician said some years ago:

> "You cannot talk about the successful professional woman without considering the support she has received from (and, hopefully, given to) other women. This mutual dependency exists all the way across the board from the housekeeper to whom she must entrust her children several hours each day to her fellow professionals."

But whether to fight to try to change the present—i.e., male—Establishment by vigorously supporting the women's movement or, instead, to devote all one's efforts to one's profession in hopes of joining the Establishment remains a problem for many professional women. This is particularly true in the sciences which require so much concentration. By refusing women's awards on the grounds such awards were "second-class", two noted American women scientists have recently spotlighted this problem. In 1971, Margaret Burbudge, now President of the American Astronomical Society, refused the Annie J. Cannon Prize in astronomy and, in 1978, Rosalyn Yalow refused the Ladies' Home Journal "Woman of the Year" award. In her letter of refusal, Dr. Yalow said:

"Some women have felt the need to strengthen their own psyches by banding together in women's groups since they, quite properly, felt rejected by the leadership of the 'male world'. Others, recognizing the existence of the problem, felt that if we were ever to move upwards we must demonstrate competence, courage and determination to succeed and must be prepared to challenge and take our place in the Establishment."

CHAPTER 3

WHAT ARE WOMEN SUPPOSED TO BE?

A basic problem for individual men and women as well as for the international women's movement lies not so much in Freud's famous question, "What do women really want? " but more in "What do people—men and women—expect women to be? " It is a problem of image. Unlike the image of men which seems to be more or less the same in most parts of the world, the image of women varies according to custom, tradition, religion and government policy.

The influence of government policy on image cannot be underestimated. This is evident from the miraculous change in how women are considered in the socialist countries. Thanks to concerted efforts in legislation, planning and above all the mass media, women are accepted as co-workers. In the Soviet Union, for example, the mass media

"... extol the accomplishments of women scientists and other professional women. The image of the hard-working, productive, and patriotic professional woman is constantly held up before the eyes of young girls; as a result, to aspire to follow in the footsteps of a famous woman scientist, physician, or engineer is perfectly natural for a girl growing up in the Soviet Union today."

Contrary to this image is the one that has been nurtured in the US. Matina S. Horner, known for her work on the "fear of success" prevalent among American women, and Mary R. Walsh have written:

"It has taken a long time to realize how sadly we have wasted and under-utilized female potential in our society ... this has been at considerable cost to both our society and to the individual women involved. We have fostered an image of femininity that emphasizes tenderness and compassion at the expense of other valuable talents and emotions."

Much prejudice stems from the fact that many necessary professional qualities, including an incisive and competitive spirit, do not go well with the tender and compassionate image: ergo, women in the professions are not "feminine" women.

Writing about "feminine" women in Latin America and in Western Europe, Argentinian woman biologist Lucia Tosi has said that they affirm their personalities through men and, because of this, they tend to channel their aggressiveness towards their own sex instead of towards their professional activity, as do men. According to Dr. Tosi, a woman feels that if she has "found the ideal man through whom she can acquire greater value, then all other women become enemies, because

if she loses him, she loses her entire self". This hostility, the need to please, ambivalence and conflict and the desire to avoid success condition women's behaviour in their professional lives. Dr. Tosi has written:

> "Only very rarely can they attain a state of readiness and display the boldness that creativity requires. Rather, what characterizes women is a certain perplexity and timidity, and the distressing sensation of being dominated by contradictory impulses. It is very difficult for them to be prepared to meet the exigencies of scientific work, which . . . imply the channelling of intellectual energies towards a single objective."

In certain developing countries of Asia and Africa, however, this situation does not seem to occur. In these nations, where the illiteracy rates for women run to more than 80 per cent, those who have managed to obtain an education appear to be able to "meet the exigencies of scientific work" and to be accepted in their fields and in their communities. This may seem strange in light of the traditional emphasis on male superiority in many of these societies. But there are at least two factors that make for the acceptance of educated women in developing countries: first, there are comparatively few qualified professionals, especially scientists—male or female—and, second, although women are considered inferior in many of these countries, they are also expected to be strong, hard-working and able managers who can run farms, market goods and generally prove their competence. In discussing the situation of career women in Kenya in comparison with women elsewhere, an educator concluded:

> "It may prove hardest for women to attain equal status in societies where there has been the myth of the equality of the sexes . . . societies where, by and large, the family is isolated and nuclear, and of necessity male and female roles within the household are more interchangeable. In these societies, it is more difficult to define maleness and femaleness in the context of specific settings, as one does in Africa or India. In these countries, a woman is submissive and passive in the presence of men but active, executive and forceful in their absence. In the societies where there are clearly defined roles for men and women and a recognized status relationship, women have always been conscious of discriminatory practices and have learned to work within the system."

One can, of course, question whether "working within the system" leads to equality. In a way, this sounds somewhat similar to Rosalyn Yalow's words about challenging and taking one's place in the Establishment. At one end of the spectrum are the women who "work within the system" and at the other are the women in the socialist countries where the system has changed. At varying degrees in between are women in most of the Western developed and in many of the developing countries. But regardless of whether the system has changed or not, the fact remains that because of traditional images of women, they must work harder to arrive at the same point as men. They generally bear the greater part of the burden of the home and children in addition to their jobs, and they usually must put forth more energy than men on their

jobs in order to be thought equal. As for professional women, one sociologist has said:

> "It is not simply that the professional woman must be more dedicated, reliable, and productive *than men* to get the same recognition; it is that she must be more dedicated, reliable, and productive than what people in general and employers in particular expect *other women* in the professions to be."

CHAPTER 4

THE OBSTACLES

"It's not being a top scientist that is a problem for women, it's getting to be one", a British woman scientist once remarked. What are the obstacles that face women who want to go into science? Directly or indirectly, they are all related to the image of what people expect women to be. The first and most formidable obstacle can be a woman's self-image. This will affect how she faces any other obstacle. The "fear of success" syndrome which, although most widespread and documented in the US, is also present to some degree in other countries, illustrates conflicting self-image. Matina S. Horner's original research and subsequent studies have shown that women tend to look upon competition, independence, intellectual achievement and leadership as basically in conflict with femininity, and thus often try consciously or unconsciously to avoid success, even though they may have previously sought this success. Even among women achievers, Horner found that they demonstrated higher achievement when working alone, and not in direct competition with men.

And who nurtures a woman's self-image? Usually her mother or other women since most small children are cared for by women. The importance of how women relate to other women has not always been recognized. A recent study notes that one hears a great deal about male discrimination but, in fact, most societies are sex segregated to a rather high degree and female mores and feminine peer pressures are much stronger than had been thought. "Women's liberation", says the study, "might be more accurately described not primarily as liberation from male domination but as liberation from the domination of their own sex".

In some places, the domination begins at birth with pink for girls as opposed to blue for boys. It continues as little girls are encouraged to play with dolls and "help mother in the kitchen" and discouraged from playing with "masculine" toys or in "masculine" games. In the same way, small boys are encouraged to follow "masculine" pursuits from which females are excluded. This cannot help but affect the attitudes of these boys when they grow up. Primary school teachers, many of whom are women, often reinforce this sexual stereotyping. As children grow older, they are frequently pressured by both parents as well as teachers of both sexes to conform to traditional ideas of what ways of life and courses of studies are appropriate—according to their sex and not their aptitudes. Boys are thought to be capable of greater "technical" understanding while girls, if they manage to pursue their

education at all, are generally guided towards "liberal arts" subjects, considered more suitable to their talents, i.e., less taxing.

The frequent admonition in English-speaking countries to be "lady-like" can apply to many things, among them to being "modest", "non-competitive" and not doing things that are considered "manly". As one author says, "If modesty and/or non-competitiveness are trained into females, then we cannot expect to change attributions without a change in society's values and in the socialization process for children".

In Africa and in other places where male superiority is generally accepted, the socialization process and values are somewhat different. According to one writer, while girls in the US and some other countries are told from their first year in primary school that they are men's equals (but then treated unequally), there is as yet little or no pretence concerning equality in Africa. Since African men thus feel free to express openly any hostility they feel towards women, the women are quite used to dealing with male antagonism in competitive and other situations. Their self-confidence and self-esteem are not weakened by it. Furthermore, African women are more able and likely to share their experiences with other women and to help each other—to bond together. Because of these factors, they are less dependent on men, accustomed to fending for themselves and providing for many of their own needs.

The African women who have gone into the professions have had the full backing of both their female peers and their families—fathers, mothers, brothers, sisters and most probably other relatives as well. Educated children can increase a family's well-being. Like a son, a daughter's education multiplies her value. Far from being a threat to male family members, an educated daughter is an asset. The encouragement she receives from the earliest years is what moulds her self-image, and a strongly positive self-image can carry a girl over the hurdles she will encounter from school onwards.

Besides the lack in many countries and regions of adequate preparatory courses in science—a problem for both girls and boys—girls continue to be discouraged from following scientific or other studies leading to a university degree by schoolteachers and school advisers. One successful black woman paediatrician in the US recalls having her high school programme changed from "college prep" to "home economics" by an adviser.

> "When my mother saw it she was outraged. Together, we went back to the school to face the adviser. The adviser attempted to placate my mother. 'Mrs. Teixeira', she pleaded, 'what is a coloured girl going to do with college? If she learns cooking and sewing, she can always get a good job'. But when we left the office, I was enrolled in the college course."

The rationalization that many teachers and, later, employers use to justify their discrimination is that training women in the professions, especially the sciences, is a waste. "Either they get married and have kids and give the whole thing up or their families come first" goes the argument. Noted French Professor Jacques Monod once sarcastically asked a student, "And

do you think, Miss X, that the bacteria are going to wait for you when your child has whooping cough?"

To the contrary, statistics prove that the higher the professional qualification of a woman, the more likely it is that she will remain working. This seems to be particularly true of women in medicine, the natural sciences and law.

Once in universities and graduate schools, women are less likely to run into the overt hostility and ridicule than they once did. Some years ago, professors and male students considered most women in their midst to be mere husband-hunters or freaks. Several women doctors who had been at medical school in the 1920s reported hearing such comments as: "I don't want *my* wife to know anything I don't teach her" and "You are not a man, you are not a woman. You are an unsexed thing, studying medicine out of morbid curiosity."

Little or no encouragement, along with a lack of suitable "role models", may 'channel women into certain specializations in the sciences. For example, outside the socialist countries, there are comparatively few women in engineering and dentistry. In the medical profession, it is rare to find women in ophthalmology, orthopaedic, thoracic, plastic and neurological surgery or in urology, gastroenterology and aviation medicine.

Noting this inequality, Assistant Director of the US National Board of Medical Examiners, Dr. Edithe Levit told a conference on Women in Medicine:

> "Fifty years ago, we would have heard the well-known phrase, 'The woman's place is in the home'. Now that we have allowed her to move into the medical world, I'm afraid we're saying, 'The woman's place is in paediatrics or child psychiatry, etc.'. I submit that we can no more say that the woman, because she is a woman, is better suited for paediatrics than she is for surgery, any more than we can say that a man, simply because he is a man, is better suited for surgery than paediatrics."

Even in a country such as Sweden, with a long history of women doctors, women tend to gravitate towards paediatrics, psychiatry, anesthesiology and obstetrics-gynaecology.

Out in the professional world, women must deal with the problem of salary differential. In the US, in only one field—engineering—are average starting salaries for women higher than those for men. Yet only five per cent of the 1977 US engineering graduates were women, a fact that one author attributes to engineering's low-status image in that country. In chemistry, employers who were surveyed said they planned to offer women graduates 95 per cent of what they would offer to men. The survey adds, "Since these plans preceded any actual hiring, this pay differential could in no way reflect differences in job performance".

The myth about "the family coming first" resulting in poorer job performance leads to an oft-heard criticism, "Women tend to demand equal rights without assuming equal responsibility". Assuming equal professional responsibility along with family responsibility means much harder work and, because of this, many women in science simply do not marry. According to a US report:

"Generally, close to half the women scientists are unmarried; the figure for men is closer to 10 per cent. Further, even when married, the women scientists have fewer children: between one-third and one-half of such women's families are childless, whereas the childless men generally comprise no more than 10 per cent of the total group."

US women physicians, on the other hand, seem more able to combine their professions, marriage and motherhood. According to the same report:

"... over three-fourths of all women physicians are married (over half, to other physicians), and the majority of them have children. In fact, those physicians who do marry have averaged three children, or slightly more children than reported by other married women in their socio-economic class. According to actual statistics, women entering medicine also have statistically a far greater probability of combining marriage and a career than women beginning graduate work in the physical or social sciences."

Regardless of whether a woman enters medicine or other scientific fields, a helpful mate can be of vital importance. An unhelpful one can undermine the most brilliant and dedicated professional woman. "For a woman to perform in two worlds, as men do", one writer states, "her marriage must countenance her dual goals and support her in seeking them". Advising girls contemplating a professional career to set high goals for themselves, independent of their sex, a prominent woman scientist has said, "If you marry, marry someone in sympathy with those goals".

A sympathetic husband can be of immeasurable help, but he cannot completely relieve his wife of maternal responsibilities. Anthropologist Margaret Mead wrote that

"... our academic tradition was initially designed by and for the celibate, the monk, the occasional nun, a kind of sexless life in which activities of the intellect were joined with a denial of the body. The academic world is fundamentally hostile, by tradition, to those acts of femininity which involve childbearing."

Sensing this hostility, women professionals often try to remain mute about their daily difficulties. A common feeling is that while men can talk freely about their families during working hours, "it is a good policy for a woman to keep her home life to herself".

The Associate Head of the Massachusetts Institute of Technology's Department of Electrical Engineering, Mildred S. Dresselhaus, in recalling her own early difficulties in combining motherhood and a career at MIT, pointed out that another outstanding woman engineer resigned rather than face this kind of hostility. She said:

"Nobody doubted that we were among the most hard-working and productive people in the lab, but we always arrived at least one hour late for work because of our commitments to our young children. Although this time-clock routine was very irritating to me, I refused to change my ways. This was going to be my lifestyle, and the administrators had to accept it."

In many developing countries, where extended families traditionally share child care, working mothers suffer neither the constant anxiety of trying to find proper people to care for their children nor the guilt of leaving them with these people. The lack of practical solutions to the child-care problem is probably the greatest obstacle that working women with children face. And, in varying degrees, this obstacle exists in socialist countries as well. Writing about women in the People's Republic of China, one author says:

> "The integration of women into the workforce is crucial to their gaining economic independence, increasing their status, and broadening their range of choices. But the liberating effect of productive work can be sharply undercut if not accompanied by adequate day-care and communal facilities, relieving women of their domestic duties. . . . The impressive percentage of women employees in the co-operatives, for example, does not reflect the fewer number of days women work because of their household responsibilities, nor the lower pay they receive for their labour."

Child-care centres, so eagerly sought by many supporters of the women's movement, are certainly a tremendous boon to many working women, but they do not always solve the problem. A well-known French sociologist has pointed out that those, for example, situated at a woman's place of work have obviously been planned by people who have never travelled on crowded public transport at rush hour with an infant or small child. In many Western countries, even when crèches and child-care centres are available, many professional women prefer to have their child cared for at home, regardless of the difficulties involved. This may also be the case in some socialist countries.

Fewer and fewer nations have a readily available pool of domestic servants. And even where such people do exist, they are sometimes unqualified. One disgruntled woman doctor in a developed country complained that the only housekeepers and babysitters who came her way were "derelicts, failures, drifters and convicts", that none stayed for more than a month, that stealing directly or indirectly was their chief diversion and that "no one ever heard of training for such a job". This seems to be a widespread problem. In reply to a United Nations survey on working women and household duties, Nigerian women complained about the very same thing.

The heavy, double workload is bound to take its toll. According to one expert, "the siphoning of imagination and energy into domestic areas during a woman's particularly creative years" is the reason women scientists with children produce fewer publications than do those who are single or childless.

In both socialist and other economies, employment in government institutes, ministries and in the area of public health offers a partial solution to several problems. Many woman scientists and doctors point to the fact that working for State-run, non-profit organizations enables them to make greater and more needed contributions to a larger and broader group of people than they could reach if they were working for private institutions, industry or in private practice. To

many of these women, public sector employment is a source of great satisfaction.

In addition, government facilities in most countries ensure equal treatment, equal pay for equal work and regular working hours. Too, they sometimes provide greater benefits in the way of dependency allowances and child-care arrangements than is often available in the private sector. But the status of a doctor or scientist working for the State is considered somewhat lower than that of a doctor in private practice or a scientist working for a private institute in Western developed and some developing countries and working for the State is not as profitable. In socialist countries, men more frequently go into industry because it pays more than medicine—a field now dominated by women. In the US, when women enter a profession on a large scale, as, for example, teaching or nursing, the status and the salaries go down; but they still remain higher for men in that profession than they do for the majority of women.

But don't many of our ideas about status and the profitability attached to it go back to the Establishment, the system? In this connexion, Indian research chemist Dolly Ghosh offers a different view of why women do not choose to enter and/or to remain in the sciences:

> "Science as a social institution has been so dehumanized by men that women can fit themselves into it only under exceptional circumstances. The large majority of women cannot forget their roles as mothers and wives, because they are more aware than men of the obligations of these human relationships. Is not the stereotyped individual in the scientific community a person who withdraws from many of his social relationships, channelling all his energy in research, competing with his colleagues not only for scientific discovery but also for position within the Establishment? Very few women can conform to these standards of behaviour."

One might well wonder if an Establishment motivated by power, prestige and profit attracts the best minds. What happened to idealism and intellectual satisfaction? Aren't they just as important? It has been said that women can serve the community as well-trained, well-qualified, humane doctors, but that, in the present scheme of things, their motivation may never equal that of men. Why? Because most of them are not out primarily to make money or to be head of the household and because part of their ego is bound up with having children.

Refreshingly, there are people in the scientific field who are motivated by other than self-serving considerations. One author, writing about the people who design, create, fabricate and build society, points out that young engineers, both men and women, go into this field because it promises "interesting work":

> "This is more important to them than money, security, prestige, or any of the other trappings of power. They seem to recognize that a fulfilling career does not have to consist of a continuous ego trip."

CHAPTER 5

REACHING FOR THE STARS?

What is the present situation of women in science throughout the world? Outside of several developed Western and socialist nations and a few developing countries, it is difficult to say with any statistical accuracy. Figures are rarely comparable. They are from different years and often women in all professions or all scientists—men and women—in one particular field are grouped together. Just sorting out the situation would be a complicated and lengthy project for a whole team of social scientists.

Even with scant information, however, it is apparent that outside the USSR, the socialist countries of Eastern Europe and China, women scientists are still a rare breed. For example, in 1974, only 14 per cent of all life and physical scientists in the US were women while they represented 38 per cent of the field in the USSR. In engineering, the figures were two per cent for the US and 28 per cent, respectively. Even with such programmes as Affirmative Action in the US (which promotes the hiring of women and members of other minority groups), little actual progress has been made. In fact, there was a higher percentage of US women in professional and technical positions during the decade between 1910 and 1920 than there ever has been since.

There are many more female lawyers, doctors and dentists in Latin America than there are in the United States, even though only 20 per cent of Latin American women are economically active. This is because those in the upper classes are often well-educated and freed from household duties by servants. Nevertheless, these professional women represent only a small minority. In Muslim countries, traditional segregation and isolation might encourage women to become doctors, according to one author, but at present they are very few and very exceptional. In 1971, there were 18 women out of a total of 589 scientists and engineers in Brunei, the only East Asian developing country listed in the last *UNESCO Statistical Yearbook* to supply separate figures for men and women in the field. There were six women out of 182 first-year science students at Tanzania's University of Dar es Salaam in 1974. Of the 30,000 entries in the 1967 *Who's Who in Science in (Western) Europe,* only two per cent were women.

More encouragingly, one quarter of all scientists and engineers in Japan in 1975 were women. But very few countries other than socialist ones can surpass let alone match that proportion.

"Our future is in our hands, but we face a world not of our choosing", Tanzanian educator Majorie Mbilinyi has written. "Only through socialism can sexual equality come about." Certainly, looking at the example of how the socialist countries have managed through government policy, laws and the media to change the image of women is worthwhile. In this connexion, the importance of political will cannot be underestimated. If Governments would actively promote equality, a part of the battle would be won.

The World Plan of Action adopted at the United Nations Conference of the International Women's Year 1975 has set forth 14 minimum objectives to be achieved hopefully by 1980. All will benefit women in every walk of life, but half of them in some way have a special bearing on the future of women of science. They include increasing literacy, extending co-educational technical and vocational training, providing equal access to every level of education, increasing employment opportunities for women, directing all education towards a re-evaluation of male and female roles, promoting interim women's organizations, and developing technology, day-care centres and energy-saving devices to help reduce women's heavy workloads.

The desire to promote the status of women and to establish a New International Economic Order, according to one writer, stems from the same universal preoccupation, namely to ensure a more even distribution of opportunities for development. This can only be successful if the problem is attacked with vigour and imagination in each country.

Much emphasis has been placed on getting women into such decision-making positions as managers, executives, leaders and, as a recent article reports, young women are beginning to aspire to these posts of power in the present Establishment. But, the article continues,

> "For better or for worse, science and technology lie at the heart of our contemporary culture, and the scientists and the technologists are akin to priests who know the secrets of the temple. Until women share in the understanding and creation of our science and technology, they will suffer from a cultural alienation that ordinary power cannot cure . . . the ultimate feminist dream will never be realized as long as women would rather supervise the world than help build it."

Taking part both in building and supervising are equally necessary. In a sense a bridge between them as far as the scientific community is concerned is provided by such organizations as AWIS (American Women in the Sciences), the Ecole d'Etudes des Ingénieurs in France, and university and professional women's associations in many countries. In addition to promoting the position of women in general and of professional women in particular, these groups provide support, employment and educational information and, in some cases, scholarships and fellowships to women. Until the scientific system is changed in many countries or until women have an equal share in the Establishment, these groups will fulfil the much-needed service of opening the doors of science to an increasing number of women.

Women who are or want to be in the sciences cannot simply stop concentrating on their work to fight single-mindedly for a changed system. If they did so, they would lose the foothold they have gained. For the time being at least, it seems necessary that professional women go on striving doubly and quite possibly triply hard, for they still carry the greater part of the family burden, they still must show their professional ability and, in addition, they are the ones who can do most to

make equal status a reality for future generations. As Dr. Rosalyn Yalow said in a United Nations speech in 1978:

"The major attack must be on the fundamental problem—namely, how women see themselves and how the social group views them in terms of their aspirations and capabilities. . . . We must believe in ourselves or no one else will believe in us; we must match our aspirations with the competence, courage and determination to succeed; and for those of us who have the good fortune to move upwards, we must feel a personal responsibility to serve as role models and advisors to ease the path for those who come afterwards. We should ask not for reverse discrimination but simply for equality of opportunity—so that those of us who wish can reach for the stars."

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